

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
8 January 2004 (08.01.2004)

PCT

(10) International Publication Number
WO 2004/003970 A3

(51) International Patent Classification⁷: **H01L 21/425**

(21) International Application Number:

PCT/US2003/019085

(22) International Filing Date: 18 June 2003 (18.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/392,023 26 June 2002 (26.06.2002) US

60/391,802 26 June 2002 (26.06.2002) US

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant (*for all designated States except US*): SEME-QUIP INC. [US/US]; 34 Sullivan Road, Unit 21, Billerica, MA 01862 (US).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): KRULL, Wade, A. [US/US]; 8 Smith Street, Marblehead, MA 01945 (US). JACOBSON, Dale, C. [US/US]; 16 Flintlock Road, Salem, NH 03079 (US).

(74) Agents: PANIAGUAS, John, S. et al.; Katten Muchin Zavis Rosenman, Suite 1600, 525 West Monroe Street, Chicago, IL 60661-3693 (US).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:
3 June 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A SEMICONDUCTOR DEVICE AND METHOD OF FABRICATING A SEMICONDUCTOR DEVICE

(57) Abstract: A method is proposed for the fabrication of the gate electrode of a semiconductor device such that the effects of gate depletion are minimized. The method is comprised of a dual deposition process wherein the first step is a very thin layer that is doped very heavily by ion implantation. The second deposition, with an associated ion implant for doping, completes the gate electrode. With the two-deposition process, it is possible to maximize the doping at the gate electrode/gate dielectric interface while minimizing risk of boron penetration of the gate dielectric. A further development of this method includes the patterning of both gate electrode layers with the advantage of utilizing the drain extension and source/drain implants as the gate doping implants and the option of offsetting the two patterns to create an asymmetric device. A method is also provided for the formation of shallow junctions in a semiconductor substrate by diffusion of dopant from an implanted layer contained within a dielectric layer into the semiconductor surface. Further, the ion implanted layer is provided with a second implanted species, such as hydrogen, in addition to the intended dopant species, wherein said species enhances the diffusivity of the dopant in the dielectric layer.

INTERNATIONAL SEARCH REPORT

Internat. application No.

PCT/US03/19085

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01L 21/425

US CL : 438/532, 563, 659

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 438/532, 558, 563, 592, 657, 659, 660

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONEElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
NONE**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 6,069,061 A (LIN et al.) 30 May 2000, Figs. 2, 4A-4E, text in col. 4, lines 28 to col. 5, line 42.	1-2, 4, 6-7, 9 ----- 3, 5, 8, 10
Y	US 5,837,598 A (ARONOWITZ et al.) 17 November 1998, col. 4, lines 1-24.	3, 5
Y	US 6,288,403 B1 (HORSKY et al.) 11 September 2001, col. 2, lines 9-43.	8, 10, 26-27
X -- Y	US 3,607,449 (TOKUYAMA et al.) 21 September 1971, Figs. 11-13, col. 3, lines 42-66.	24-25, 29-30 ----- 26-28

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"I"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"I" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"G"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

20 JANUARY 2004

Date of mailing of the international search report

19 APR 2004

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

CHANDRA CHAUDHARI

Telephone No. (703) 308-0956

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/19085

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,801,086 A (LEE et al.) 1 September 1998, col. 3, lines 8-57.	28